PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-120818

(43)Date of publication of application : 06.05.1997

(51)Int.Cl. H01M 4/66
H01M 10/40

(21)Application number : 07-279227

(22)Date of filing : 26.10.1995

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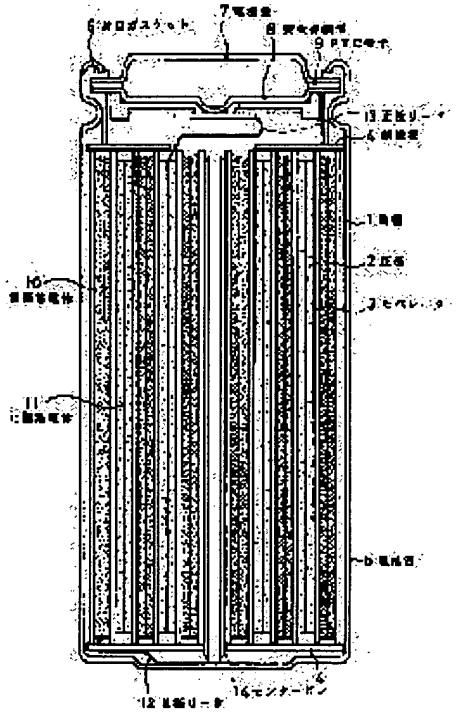
(54) NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To construct light a secondary battery with a nonaqueous electrolyte using a lightweight current collector by forming the collectors of the positive and the negative electrode from a conductive film of resin where a conductive metal is provided as the surface layer.

SOLUTION: A nonaqueous electrolyte secondary battery concerned is composed of a positive electrode made of LixMO2 (M is one of the elements Ni, Co, Fe, and Mn) and a negative electrode made of lithium metal, lithium alloy, or a carbonic substance capable of doping and dedoping the lithium. If a conductive film of resin having a conductive metal as the surface layer is used for the current collector of both or either of the positive and negative electrodes, the collector can be made light in weight, which should lead to a lightweight construction of the resultant secondary battery.



LEGAL STATUS

[Date of request for examination] 04.09.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] The nonaqueous electrolyte rechargeable battery characterized by having used Lix MO2 (it coming to be chosen out of M=nickel, and Co, Fe and Mn) for the positive electrode, and using for a negative electrode the conductive thin film which has a conductive metal on a surface at the resin sheet-like film in the nonaqueous electrolyte rechargeable battery using the carbon material in which a dope / dedope of a lithium metal, a lithium alloy, or a lithium are possible as the both sides of a positive electrode and a negative electrode, or one of charge collectors.
[Claim 2] The resin sheet-like film is a nonaqueous electrolyte rechargeable battery according to claim 1 characterized by consisting of polyester, a polyether ether ketone, polyimide, or polyolefine.
[Claim 3] The resin sheet-like film is a nonaqueous electrolyte rechargeable battery according to claim 1 characterized by being in the range the thickness of whose is 5-20 micrometers.
[Claim 4] A conductive metal is a nonaqueous electrolyte rechargeable battery according to claim 1 characterized by being copper, nickel, or aluminum.
[Claim 5] A conductive metal is a nonaqueous electrolyte rechargeable battery according to claim 1 characterized by being in the range the thickness of whose is 0.05-2 micrometers.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is applied to the power source of small electronic equipment, such as a cellular phone, a headphone stereo cassette tape recorder, a CD player, and a personal computer, and relates to a suitable nonaqueous electrolyte rechargeable battery.
[0002]
[Description of the Prior Art] Development of small electronic equipment, such as a cellular phone, a headphone stereo cassette tape recorder, a CD player, and a personal computer, is remarkable in recent years, and the request to the small mass power source used for these applications is large. The lithium ion battery has been put in practical use by the mass NiMH cell pan from the lead cell or the NiCd cell for [these] applications.
[0003] Especially a rechargeable lithium-ion battery is most promising cell that can suit a small lightweight cell. It is LiCoO2 to a positive electrode. Or LiNiO2 and LiMn 2O4 It uses, and in order to raise the engine performance of a nonaqueous electrolyte cell to a negative electrode in the nonaqueous electrolyte rechargeable battery which used for the negative electrode the carbon in which a dope / dedope of a metal lithium or a lithium are possible, the thin electrode made into the big electrode surface product is used.
[0004] As a process of this thin electrode, the electrode which applied a positive electrode or negative-electrode active material mixture to the metallic foil has been used in recent years with the electrode which applied the mixture of positive active material to the metal network from the former.

[0005] The metal network mold electrode has mainly been used for the eddy winding pattern cell of a primary cell. One metallic foil mold electrode has mainly been used for the eddy winding pattern cell of a nonaqueous cell.
[0006] It was the thing which all contribute to the discharge engine performance of a nonaqueous electrolyte cell, or the improvement in shelf-life ability, and make demonstrate the description of the improvement in effectiveness of electrode manufacture.
[0007]
[Problem(s) to be Solved by the Invention] However, lightweight-izing of a cell and discharge capacity increase are searched for with the improvement in the engine performance of a small cell in recent years. The weight increases the cell using the electrode using a metaled network and a metaled metallic foil, and there is a limitation in lightweight-ization.
[0008] If a cell especially furthers development aiming at a big cell from a small thing, the rate of the volume/weight of the charge collector metallurgy group lead object occupied in a cell will become large, and the energy density of a cell will fall. In case a cell is enlarged especially, the volume/weight of a current collection part to a terminal lead part increase.
[0009] The interest with these former not much serious points is not held, and does not need to be

taken into consideration by the non-portable cell as an application of a cell. In case it develops as a movable power source as an application new from now on, it can be said to be what becomes a very important point.

[0010] This invention is made in view of such a technical problem, and it aims at offering the nonaqueous electrolyte rechargeable battery which can aim at improvement in weight energy density.

[0011]

[Means for Solving the Problem] The nonaqueous electrolyte rechargeable battery of this invention uses Lix MO2 (it comes to be chosen out of M=nickel, and Co, Fe and Mn) for a positive electrode, and uses for a negative electrode the conductive thin film which has a conductive metal on a surface at the resin sheet-like film in the nonaqueous electrolyte rechargeable battery using the carbon material in which a dope / dedope of a lithium metal, a lithium alloy, or a lithium are possible as the both sides of a positive electrode and a negative electrode, or one of charge collectors.

[0012] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration by which the resin sheet-like film consists of polyester, a polyether ether ketone, polyimide, or polyolefine.

[0013] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration in the range whose thickness of the resin sheet-like film is 5-20 micrometers.

[0014] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration whose conductive metal is copper, nickel, or aluminum.

[0015] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration in the range whose thickness of a conductive metal is 0.05-2 micrometers.

[0016] According to the nonaqueous electrolyte rechargeable battery of this invention, by having used for the resin sheet-like film the conductive thin film which has a conductive metal on a surface as the both sides of a positive electrode and a negative electrode, or one of charge collectors, weight of a cell can be made light and-izing of the charge collector can be carried out [lightweight] to about 1 / four to 1/6 in the comparison only by part for a current collection soma as compared with the cell using metal copper foil / network especially as current collection material.

[0017]

[Embodiment of the Invention] Hereafter, it explains, referring to drawing 1 and drawing 2 about the example of this invention nonaqueous electrolyte rechargeable battery. First, the concrete contents of examples 1-11 and the examples 1-4 of a comparison are explained.

[0018] As example 1 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 500A to both sides for positive electrodes was produced.

[0019] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 500A to both sides for negative electrodes was produced.

[0020] As positive-electrode material, after calcinating for 8 hours and cooling to a room temperature, it ground and the active material with a mean particle diameter of 20 micrometers was obtained under the 900-degree C condition, in the air after carrying out specified quantity measuring of a lithium carbonate and the cobalt carbonate and mixing enough with a mortar, so that a lithium and cobalt might be set to 1 to 1 by the mole ratio. This active material is LiCoO2 at powder X-ray diffractometry. It was the ingredient which has a diffraction peak in agreement.

[0021] this LiCoO2 as 91 % of the weight and electric conduction material -- graphite -- as 6 % of the weight and a binder -- polyvinylidene fluoride (PVDF) -- 3 % of the weight -- mixing -- as a

distributed solvent -- N methyl 2 pyrrolidone -- adding -- a positive electrode -- a mixture -- it considered as the paste.
[0022] this positive electrode -- a mixture -- carry out homogeneity spreading, the above-mentioned aluminum vacuum evaporationo conductivity PET sheet was made to dry a paste to both sides, and it considered as positive-electrode electrode material.
[0023] Pressurization molding of this positive-electrode electrode material was carried out with the roller press machine, and it judged in predetermined magnitude with a width of face [of 54mm], and a die length of 470mm, and 4mmx100mm lead material was bent by the thickness of 50 micrometers made from aluminum at the end two, and it fixed to the front face using the pressurization machine which gave irregularity, and considered as the positive electrode.
[0024] After introducing into a negative electrode the functional group which contains oxygen in this, using a petroleum pitch as a raw material 10 to 20% (the so-called oxygen bridge formation), 1000 degrees C was heat-treated under the inert gas ambient atmosphere, and the carbon material with the property near glassy carbon was obtained. As a result of performing X diffraction measurement of this ingredient, the spacing of d (002) side was 3.76A. This ingredient was ground and it considered as carbon material powder with a mean particle diameter of 20 micrometers.
[0025] thus, the obtained carbon material powder -- a negative-electrode active material -- carrying out -- this -- as 90 % of the weight and a binder -- 10 % of the weight (PVDF) of polyvinylidene fluorides -- mixing -- a negative electrode -- this negative electrode used as the mixture -- a mixture -- distributed solvent N methyl 2 pyrrolidone -- distributing -- a negative electrode -- a mixture -- it considered as the paste.
[0026] this negative electrode -- a mixture -- carry out double-sided homogeneity spreading, the above-mentioned nickel vacuum evaporationo conductivity PET sheet was made to dry a paste, and it considered as negative-electrode electrode material. Pressurization molding of this negative-electrode electrode material was carried out with the roller press machine, and it judged in predetermined magnitude with a width of face [of 57mm], and a die length of 510mm, fixed using the pressurization machine which bent the 4mmx100mm lead material made from nickel by the thickness of 100 micrometers at the end two, and attached unevenness to the front face, and considered as the negative electrode.
[0027] Using the fine porosity film made from polypropylene as these positive electrodes, a negative electrode, and a separator, the laminating was carried out in the sequence of a positive electrode / separator / negative electrode / separator, and after winding many times so that it may go into a cylindrical cell can with a diameter of 18mm, the winding object was fixed for the periphery using the tape.
[0028] As shown in drawing 1 , the electric insulating plate 4 was inserted for this winding object up and down, and it put into the cell can 5 with a diameter of 18mm, welding immobilization of the negative-electrode lead 12 was carried out at the cell can 5, and the positive-electrode lead 13 was welded to relief valve equipment 8.
[0029] After pouring in the electrolytic solution which comes to dissolve LiPF6 in the mixed liquor of propylene carbonate and diethyl carbonate as the electrolytic solution here, it laid, and the PTC component (forward temperature coefficient component) 9 and the cell lid 7 were caulking-**(ed), and were obturated, and it considered as the cell with a diameter [of 18mm], and a height of 65mm. The weight of the assembled cell was 36.8g.
[0030] As example 2 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 1000A to both sides for positive electrodes was produced.
[0031] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the

thickness of 1000A to both sides for negative electrodes was produced.
[0032] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0033] which was 36.8g. As example 3 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 18 micrometers, and fabricated aluminum by the thickness of 2000A to both sides for positive electrodes was produced.
[0034] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 20 micrometers, and fabricated nickel by the thickness of 2000A to both sides for negative electrodes was produced.
[0035] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0036] which was 36.8g. As example 4 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylenenaphthalate (PEN) thickness of 14 micrometers, and fabricated aluminum by the thickness of 500A to both sides for positive electrodes was produced.
[0037] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene CHIREN naphthalate (PEN) thickness of 14 micrometers, and fabricated copper by the thickness of 1000A to both sides for negative electrodes was produced.
[0038] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0039] which was 36.8g. As example 5 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 20 micrometers, and fabricated aluminum by the thickness of 1000A to both sides for positive electrodes was produced.
[0040] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene CHIREN terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 500A to both sides for negative electrodes was produced.
[0041] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0042] which was 37.0g. As example 6 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polybutylene tele free-wheel-plate rhe T (PBT) thickness of 15 micrometers, and fabricated aluminum by the thickness of 1000A to both sides for positive electrodes was produced.
[0043] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polybutylene terephthalate (PBT) thickness of 15 micrometers, and fabricated nickel by the thickness of 1000A to both sides for negative electrodes was produced.
[0044] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0045] which was 36.8g. As example 7 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 2000A to both sides for positive electrodes was produced.
[0046] The conductive liner sheet which cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, cast copper by thickness of 500A to both sides for negative electrodes, cast by the nonelectrolytic plating method next and cast copper by thickness of 1 micrometer to both sides was produced.
[0047] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is

[0048] which was 37.3g. As example 8 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 5000A to both sides for positive electrodes was produced.
[0049] 500A of copper was cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers for negative electrodes, and the conductive liner sheet fabricated with the nonelectrolytic plating method to both sides by the thickness of 2 micrometers was produced.
[0050] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0051] which was 37.9g. The conductive liner sheet which cast 500A of aluminum by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 10 micrometers for positive electrodes, and fabricated aluminum with the electrolysis galvanizing method to both sides by the thickness of 1 micrometer as example 9 resin sheet-like conductivity film was produced.

[0052] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 2000A to both sides for negative electrodes was produced.
[0053] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0054] which was 37.0g. As example 10 resin sheet-like conductivity film, 500A of aluminum was cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers for positive electrodes, and the conductive liner sheet which fabricated aluminum with the electrolysis galvanizing method to both sides by the thickness of 2 micrometers was produced.
[0055] 500A of copper was cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers for negative electrodes, and the conductive liner sheet which fabricated copper with the nonelectrolytic plating method to both sides by the thickness of 0.5 micrometers was produced.
[0056] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0057] which was 37.2g. The charge collector of 10 micrometers of copper foil was used for the negative electrodes which produced the electrode to positive electrodes, using the charge collector which cast aluminum by the vacuum deposition method to polyethylene terephthalate (PET) 14micrometer, and cast it by thickness of 1000A to both sides as example 11 charge collector, and the electrode was produced.
[0058] Using the above-mentioned conductive liner sheet, the positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0059] which was 39.2g. The charge collector of 10 micrometers of copper foil was used for the negative electrodes which used the charge collector of aluminum 20micrometer thickness for positive electrodes as example of comparison 1 charge collector, and produced the electrode, and the electrode was produced.
[0060] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0061] which was 40.0g. The charge collector of 10 micrometers of nickel foils was used for the negative electrodes which used the charge collector of 20 micrometer thickness of nickel foils for positive electrodes as example of comparison 2 charge collector, and produced the electrode, and the electrode was produced.
[0062] The positive electrode and the negative electrode were produced like the example 1, and

assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0063] which was 41.9g. The thickness of 20 micrometers of aluminium foil was used for positive electrodes as example of comparison 3 charge collector, the stainless steel 304 foil thickness of 10 micrometers was used for the negative electrodes which produced the electrode, and the electrode was produced.

[0064] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0065] which was 39.2g. As example of comparison 4 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 500A to both sides for positive electrodes was produced.

[0066] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated copper by the thickness of 200A to both sides for negative electrodes was produced.

[0067] Using the above-mentioned conductive liner sheet, the positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0068] which was 36.7g. It is Table 1 which summarized the quality of the material of a positive-electrode current collection layer, the quality of the material and thickness of the thickness and a negative-electrode current collection layer, and cell weight about the above examples 1-11 and examples 1-4 of a comparison.

[0069]

[Table 1]

	正極集電体	厚み	負極集電体	厚み	電池重量
実施例1	アルミニウム	500Å	ニッケル	500Å	36.8g
実施例2	アルミニウム	1000Å	ニッケル	1000Å	36.8g
実施例3	アルミニウム	2000Å	ニッケル	2000Å	36.8g
実施例4	アルミニウム	500Å	銅	1000Å	36.8g
実施例5	アルミニウム	1000Å	ニッケル	500Å	37.0g
実施例6	アルミニウム	1000Å	ニッケル	1000Å	36.8g
実施例7	アルミニウム	2000Å	銅	1μm	37.3g
実施例8	アルミニウム	5000Å	銅	2μm	37.9g
実施例9	アルミニウム	1μm	ニッケル	2000Å	37.0g
実施例10	アルミニウム	2μm	銅	0.5μm	37.2g
実施例11	アルミニウム	1000Å	銅	10μm	39.2g
比較例1	アルミニウム	20μm	銅	10μm	40.0g
比較例2	ニッケル	20μm	ニッケル	10μm	41.9g
比較例3	アルミニウム	20μm	SUS	10μm	39.2g
比較例4	アルミニウム	500Å	銅	200Å	36.7g

[0070] Next, the cycle which carries out 3.5hr charge by charging current 0.5A and upper limit electrical-potential-difference 4.20V, uses a 6-ohm resistance element next using the cell of the examples 1-11 shown in Table 1 and the examples 1-4 of a comparison, and is made to discharge to 2.5V was performed. The result of having measured an internal resistance value, 5 cycle eye

discharge capacity, 10 cycle eye discharge capacity, weight energy density, 100 cycle eye discharge capacity, and 2A load discharge capacity about the cell of examples 1-11 and the examples 1-4 of a comparison is as being shown in Table 2.

[0071]

[Table 2]

	内部抵抗値 at1kHz	5サイクル目放電容量	10サイクル目放電容量	重量エネルギー密度	100サイクル目放電容量	2A負荷放電容量
実施例1	68mΩ	1230mAh	1200mAh	115 Wh/kg	1105mAh	850mAh
実施例2	70mΩ	1250mAh	1210mAh	114 Wh/kg	1110mAh	845mAh
実施例3	69mΩ	1230mAh	1200mAh	114 Wh/kg	1100mAh	820mAh
実施例4	69mΩ	1210mAh	1190mAh	114 Wh/kg	1090mAh	815mAh
実施例5	66mΩ	1250mAh	1210mAh	115 Wh/kg	1100mAh	840mAh
実施例6	68mΩ	1230mAh	1200mAh	114 Wh/kg	1095mAh	820mAh
実施例7	70mΩ	1220mAh	1200mAh	115 Wh/kg	1090mAh	810mAh
実施例8	68mΩ	1220mAh	1200mAh	113 Wh/kg	1080mAh	820mAh
実施例9	71mΩ	1210mAh	1190mAh	115 Wh/kg	1090mAh	800mAh
実施例10	70mΩ	1215mAh	1190mAh	115 Wh/kg	1080mAh	790mAh
実施例11	65mΩ	1230mAh	1210mAh	110 Wh/kg	1090mAh	730mAh
比較例1	63mΩ	1250mAh	1210mAh	109 Wh/kg	1100mAh	840mAh
比較例2	70mΩ	1250mAh	1210mAh	104 Wh/kg	1050mAh	790mAh
比較例3	75mΩ	1200mAh	1180mAh	109 Wh/kg	1060mAh	780mAh
比較例4	78mΩ	1125mAh	1100mAh	102 Wh/kg	1010mAh	610mAh

[0072] Thus, the engine performance in which all of the charge-and-discharge cycle engine performance are almost equivalent is obtained, and while charge and discharge can be equal to practical use, in case a cell is applied to portable, it is very much effective [it acts advantageously, and] from that the weight of a cell can carry out [lightweight]-izing not using a metallic charge collector. Even if it faces weight energy density improving also by the above-mentioned result, and newly enlarging a cell, effectiveness is large, it is lightweight in a cell, and it is effective in case what has an output big moreover is made.

[0073] Moreover, by using the resin sheet for the sheet-like film of a charge collector, since the resin sheet with which the impact at the time of fall is distributed by both a separator and the current collection sheet has elasticity, it does not concentrate on one place like a metal body, but the surroundings also transform it, and it does not result in too much stress concentration.

[0074] Since it is resin, therefore it does not carry out linear fracture seen with a metal but becomes the destruction the sheet itself goes out [destruction] with elongation and it goes to a certain force, instantaneous fracture with the whole charge collector is not carried out, but the gestalt destroyed gradually is taken.

[0075] Lightweight-izing of a cell is possible by using the thin film object of the resin sheet which has a conductive metal on a front face as a charge collector of an electrode from the above thing according to this example, and using the sheet which has the conductivity in the range of this invention also from the point that the engine performance equivalent to the metallic foil used from the former can be demonstrated by having this predetermined conductive layer thickness makes

effectiveness size extremely.
[0076] In order to have the reinforcement of a sheet above to some extent in order to apply positive/negative Mix practical about the thickness of the resin sheet used as a conductive current collection sheet, and to maintain the homogeneity of a paint film, the breaking strength of 3 or more kgf/cm is required so that hauling by the machine can be borne. It is desirable to use the sheet of 4 kgf/cm from from [in maintaining especially the homogeneity of a paint film].
[0077] In order to prevent that manufacture of a conductive thin film becomes difficult as thickness of a conductive thin film, it is desirable that it is 5 micrometers or more. Moreover, it is desirable that it is 20 micrometers or less from membranous reinforcement, the moldability of an electrode, and the point of cell weight.
[0078] What has the thinner electric conduction film from lightweight-izing of a cell is desirable, and it is desirable that it is in the range which is about 0.05-2 micrometers of one side (refer to drawing 2). Moreover, in order to secure a flow with an active material, a certain thing of electric conduction film thickness is desirable about 0.02 micrometers or more.
[0079] In addition, this invention is not limited to the example mentioned above not necessarily. That is, as resin sheet-like film, others, other polyester, a polyether ether ketone, polyimide, or polypropylene etc. can be used. [polyester /, such as PET, PBT, or PEN]
[0080] Moreover, when using as a positive electrode as a conductive metal of the surface of the sheet-like film, nickel platinum besides aluminum or nickel, titanium, or zinc can be used. Moreover, when using as a negative electrode, palladium besides copper, nickel, or SUS, silver, or titanium can be used.
[0081] Moreover, as the shaping approach of the surface electric conduction film, the method of sticking an electrolytic plating foil (2 micrometers or less) besides a vacuum deposition method or an electroless deposition method by pressure or the metal **** thin film fabricating method can be used.
[0082] Moreover, it is realizable also about the manufacture approach of an electrode also except the approach of describing at this example. The active material of an electrode can use various things, and if it is a nonaqueous electrolyte cell, it can especially apply all.
[0083] as positive active material -- LiCoO2 others -- LiNiO2 -- LiCoxNi1-x O2, LiMn 2O4, and LiMnO2, LiFeO2, MoO2, MoO3, MoS2, and TiS2, LiTiO2, V2 O5, V3 O6, Lix VOy, and MnO2 Various ingredients are usable. etc. -- Other carbon and lithium metallic compounds of a metal lithium besides the carbon material near glassy carbon as a negative-electrode active material in which a dope / dedope of a lithium alloy and a lithium are possible natural are usable.
[0084] Moreover, the configuration of a cell is applicable to configurations, such as plate-like besides cylindrical, and a rectangular parallelepiped.
[0085] Moreover, as for this invention, it is needless to say that various configurations can be taken in addition to this, without deviating from the summary of not only an above-mentioned example but this invention.
[0086]
[Effect of the Invention] A more highly efficient cell can be manufactured by using the approach of this invention for energy density being large, and being lightweight, and it being difficult to make it a cell applicable to a large-sized cell moreover, and attaining the engine performance / lightweight-ization to various cells by the conventional approach, as explained above.
[0087] The cell which used for the cell the electrode which applied a positive electrode or negative-electrode active material mixture to the conductive thin film which has a conductive metal in the charge collector of this invention, i.e., the resin sheet-like film, at a surface can make weight of a cell light, and can carry out [lightweight]-izing of the charge collector to about 1 / four to 1/6 in the comparison only by part for a current collection soma as compared with the cell using metal copper foil / network especially as current collection material.

[0088] When a resin sheet uses polyester, a polyether ether ketone, and polyimide, increase of binding capacity with a binder can be expected and the effectiveness that HAKURI from the current carrying part of an active material and omission can be prevented can be expected collectively.
[0089] It becomes possible to use polyester resin, polyethylene, etc. else [, such as polyvinylidene fluoride and polytetrafluoroethylene,] as a binder of an active material, electrode manufacture becomes easy, and effectiveness is in price reduction.
[0090] Furthermore the impact absorption in the part of the conductive film can be expected, and the impact of vibration can be eased.
[0091] Melting happens because the time of abnormality generation of heat of a cell or the current collection device of the electrode in the local febrile state, and a current collection device are resin sheet-like film, and a conductive halt can be expected.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention is applied to the power source of small electronic equipment, such as a cellular phone, a headphone stereo cassette tape recorder, a CD player, and a personal computer, and relates to a suitable nonaqueous electrolyte rechargeable battery.

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PRIOR ART

[Description of the Prior Art] Development of small electronic equipment, such as a cellular phone, a headphone stereo cassette tape recorder, a CD player, and a personal computer, is remarkable in recent years, and the request to the small mass power source used for these applications is large. The lithium ion battery has been put in practical use by the mass NiMH cell pan from the lead cell or the NiCd cell for [these] applications.
[0003] Especially a rechargeable lithium-ion battery is most promising cell that can suit a small lightweight cell. It is LiCoO2 to a positive electrode. Or LiNiO2 and LiMn 2O4 It uses, and in order to raise the engine performance of a nonaqueous electrolyte cell to a negative electrode in the nonaqueous electrolyte rechargeable battery which used for the negative electrode the carbon in which a dope / dedope of a metal lithium or a lithium are possible, the thin electrode made into the big electrode surface product is used.
[0004] As a process of this thin electrode, the electrode which applied a positive electrode or negative-electrode active material mixture to the metallic foil has been used in recent years with the electrode which applied the mixture of positive active material to the metal network from the former.

[0005] The metal network mold electrode has mainly been used for the eddy winding pattern cell of a primary cell. One metallic foil mold electrode has mainly been used for the eddy winding pattern cell of a nonaqueous cell.
[0006] It was the thing which all contribute to the discharge engine performance of a nonaqueous electrolyte cell, or the improvement in shelf-life ability, and make demonstrate the description of the improvement in effectiveness of electrode manufacture.

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EFFECT OF THE INVENTION

[Effect of the Invention] A more highly efficient cell can be manufactured by using the approach of this invention for energy density being large, and being lightweight, and it being difficult to make it a cell applicable to a large-sized cell moreover, and attaining the engine performance / lightweight-ization to various cells by the conventional approach, as explained above.
[0087] The cell which used for the cell the electrode which applied a positive electrode or negative-electrode active material mixture to the conductive thin film which has a conductive metal in the charge collector of this invention, i.e., the resin sheet-like film, at a surface can make weight of a cell light, and can carry out [lightweight]-izing of the charge collector to about 1 / four to 1/6 in the comparison only by part for a current collection soma as compared with the cell using metal copper foil / network especially as current collection material.
[0088] When a resin sheet uses polyester, a polyether ether ketone, and polyimide, increase of binding capacity with a binder can be expected and the effectiveness that HAKURI from the current carrying part of an active material and omission can be prevented can be expected collectively.
[0089] It becomes possible to use polyester resin, polyethylene, etc. else [, such as polyvinylidene fluoride and polytetrafluoroethylene,] as a binder of an active material, electrode manufacture becomes easy, and effectiveness is in price reduction.
[0090] Furthermore the impact absorption in the part of the conductive film can be expected, and the impact of vibration can be eased.
[0091] Melting happens because the time of abnormality generation of heat of a cell or the current collection device of the electrode in the local febrile state, and a current collection device are resin sheet-like film, and a conductive halt can be expected.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, lightweight-izing of a cell and discharge capacity increase are searched for with the improvement in the engine performance of a small cell in recent years. The weight increases the cell using the electrode using a metaled network and a metaled metallic foil, and there is a limitation in lightweight-ization.
[0008] If a cell especially furthers development aiming at a big cell from a small thing, the rate of the volume/weight of the charge collector metallurgy group lead object occupied in a cell will become large, and the energy density of a cell will fall. In case a cell is enlarged especially, the volume/weight of a current collection part to a terminal lead part increase.
[0009] The interest with these former not much serious points is not held, and does not need to be taken into consideration by the non-portable cell as an application of a cell. In case it develops as a movable power source as an application new from now on, it can be said to be what becomes a very important point.
[0010] This invention is made in view of such a technical problem, and it aims at offering the nonaqueous electrolyte rechargeable battery which can aim at improvement in weight energy density.

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MEANS

[Means for Solving the Problem] The nonaqueous electrolyte rechargeable battery of this invention uses Lix MO2 (it comes to be chosen out of M=nickel, and Co, Fe and Mn) for a positive electrode, and uses for a negative electrode the conductive thin film which has a conductive metal on a surface at the resin sheet-like film in the nonaqueous electrolyte rechargeable battery using the carbon material in which a dope / dedope of a lithium metal, a lithium alloy, or a lithium are possible as the both sides of a positive electrode and a negative electrode, or one of charge collectors.
[0012] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration by which the resin sheet-like film consists of polyester, a polyether ether ketone, polyimide, or polyolefine.
[0013] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration in the range whose thickness of the resin sheet-like film is 5-20 micrometers.
[0014] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration whose conductive metal is copper, nickel, or aluminum.
[0015] Moreover, the nonaqueous electrolyte rechargeable battery of this invention is a cell of the above-mentioned configuration in the range whose thickness of a conductive metal is 0.05-2 micrometers.
[0016] According to the nonaqueous electrolyte rechargeable battery of this invention, by having used for the resin sheet-like film the conductive thin film which has a conductive metal on a surface as the both sides of a positive electrode and a negative electrode, or one of charge collectors, weight of a cell can be made light and-izing of the charge collector can be carried out [lightweight] to about 1 / four to 1/6 in the comparison only by part for a current collection soma as compared with the cell using metal copper foil / network especially as current collection material.
[0017]
[Embodiment of the Invention] Hereafter, it explains, referring to drawing 1 and drawing 2 about the example of this invention nonaqueous electrolyte rechargeable battery. First, the concrete contents of examples 1-11 and the examples 1-4 of a comparison are explained.
[0018] As example 1 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 500A to both sides for positive electrodes was produced.
[0019] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 500A to both sides for negative electrodes was produced.
[0020] As positive-electrode material, after calcinating for 8 hours and cooling to a room temperature, it ground and the active material with a mean particle diameter of 20 micrometers was obtained under the 900-degree C condition, in the air after carrying out specified quantity measuring

of a lithium carbonate and the cobalt carbonate and mixing enough with a mortar, so that a lithium and cobalt might be set to 1 to 1 by the mole ratio. This active material is LiCoO2 at powder X-ray diffractometry. It was the ingredient which has a diffraction peak in agreement.
[0021] this LiCoO2 as 91 % of the weight and electric conduction material -- graphite -- as 6 % of the weight and a binder -- polyvinylidene fluoride (PVDF) -- 3 % of the weight -- mixing -- as a distributed solvent -- N methyl 2 pyrrolidone -- adding -- a positive electrode -- a mixture -- it considered as the paste.
[0022] this positive electrode -- a mixture -- carry out homogeneity spreading, the above-mentioned aluminum vacuum evaporationo conductivity PET sheet was made to dry a paste to both sides, and it considered as positive-electrode electrode material.
[0023] Pressurization molding of this positive-electrode electrode material was carried out with the roller press machine, and it judged in predetermined magnitude with a width of face [of 54mm], and a die length of 470mm, and 4mmx100mm lead material was bent by the thickness of 50 micrometers made from aluminum at the end two, and it fixed to the front face using the pressurization machine which gave irregularity, and considered as the positive electrode.
[0024] After introducing into a negative electrode the functional group which contains oxygen in this, using a petroleum pitch as a raw material 10 to 20% (the so-called oxygen bridge formation), 1000 degrees C was heat-treated under the inert gas ambient atmosphere, and the carbon material with the property near glassy carbon was obtained. As a result of performing X diffraction measurement of this ingredient, the spacing of d (002) side was 3.76A. This ingredient was ground and it considered as carbon material powder with a mean particle diameter of 20 micrometers.
[0025] thus, the obtained carbon material powder -- a negative-electrode active material -- carrying out -- this -- as 90 % of the weight and a binder -- 10 % of the weight (PVDF) of polyvinylidene fluorides -- mixing -- a negative electrode -- this negative electrode used as the mixture -- a mixture -- distributed solvent N methyl 2 pyrrolidone -- distributing -- a negative electrode -- a mixture -- it considered as the paste.
[0026] this negative electrode -- a mixture -- carry out double-sided homogeneity spreading, the above-mentioned nickel vacuum evaporationo conductivity PET sheet was made to dry a paste, and it considered as negative-electrode electrode material. Pressurization molding of this negative-electrode electrode material was carried out with the roller press machine, and it judged in predetermined magnitude with a width of face [of 57mm], and a die length of 510mm, fixed using the pressurization machine which bent the 4mmx100mm lead material made from nickel by the thickness of 100 micrometers at the end two, and attached unevenness to the front face, and considered as the negative electrode.
[0027] Using the fine porosity film made from polypropylene as these positive electrodes, a negative electrode, and a separator, the laminating was carried out in the sequence of a positive electrode / separator / negative electrode / separator, and after winding many times so that it may go into a cylindrical cell can with a diameter of 18mm, the winding object was fixed for the periphery using the tape.
[0028] As shown in drawing 1 , the electric insulating plate 4 was inserted for this winding object up and down, and it put into the cell can 5 with a diameter of 18mm, welding immobilization of the negative-electrode lead 12 was carried out at the cell can 5, and the positive-electrode lead 13 was welded to relief valve equipment 8.
[0029] After pouring in the electrolytic solution which comes to dissolve LiPF6 in the mixed liquor of propylene carbonate and diethyl carbonate as the electrolytic solution here, it laid, and the PTC component (forward temperature coefficient component) 9 and the cell lid 7 were caulking-**(ed), and were obturated, and it considered as the cell with a diameter [of 18mm], and a height of 65mm. The weight of the assembled cell was 36.8g.
[0030] As example 2 resin sheet-like conductivity film, the conductive liner sheet which fabricated

with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 1000A to both sides for positive electrodes was produced.
[0031] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 1000A to both sides for negative electrodes was produced.
[0032] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0033] which was 36.8g. As example 3 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 18 micrometers, and fabricated aluminum by the thickness of 2000A to both sides for positive electrodes was produced.
[0034] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 20 micrometers, and fabricated nickel by the thickness of 2000A to both sides for negative electrodes was produced.
[0035] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0036] which was 36.8g. As example 4 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylenenaphthalate (PEN) thickness of 14 micrometers, and fabricated aluminum by the thickness of 500A to both sides for positive electrodes was produced.
[0037] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene CHIREN naphthalate (PEN) thickness of 14 micrometers, and fabricated copper by the thickness of 1000A to both sides for negative electrodes was produced.
[0038] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0039] which was 36.8g. As example 5 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 20 micrometers, and fabricated aluminum by the thickness of 1000A to both sides for positive electrodes was produced.
[0040] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene CHIREN terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 500A to both sides for negative electrodes was produced.
[0041] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0042] which was 37.0g. As example 6 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polybutylene tele free-wheel-plate rhe T (PBT) thickness of 15 micrometers, and fabricated aluminum by the thickness of 1000A to both sides for positive electrodes was produced.
[0043] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polybutylene terephthalate (PBT) thickness of 15 micrometers, and fabricated nickel by the thickness of 1000A to both sides for negative electrodes was produced.
[0044] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0045] which was 36.8g. As example 7 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 2000A to both sides for positive electrodes was produced.
[0046] The conductive liner sheet which cast by the vacuum deposition method on the film with a

polyethylene terephthalate (PET) thickness of 14 micrometers, cast copper by thickness of 500A to both sides for negative electrodes, cast by the nonelectrolytic plating method next and cast copper by thickness of 1 micrometer to both sides was produced.
[0047] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0048] which was 37.3g. As example 8 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 5000A to both sides for positive electrodes was produced.
[0049] 500A of copper was cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers for negative electrodes, and the conductive liner sheet fabricated with the nonelectrolytic plating method to both sides by the thickness of 2 micrometers was produced.
[0050] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0051] which was 37.9g. The conductive liner sheet which cast 500A of aluminum by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 10 micrometers for positive electrodes, and fabricated aluminum with the electrolysis galvanizing method to both sides by the thickness of 1 micrometer as example 9 resin sheet-like conductivity film was produced.

[0052] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated nickel by the thickness of 2000A to both sides for negative electrodes was produced.
[0053] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0054] which was 37.0g. As example 10 resin sheet-like conductivity film, 500A of aluminum was cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers for positive electrodes, and the conductive liner sheet which fabricated aluminum with the electrolysis galvanizing method to both sides by the thickness of 2 micrometers was produced.
[0055] 500A of copper was cast by the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers for negative electrodes, and the conductive liner sheet which fabricated copper with the nonelectrolytic plating method to both sides by the thickness of 0.5 micrometers was produced.
[0056] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0057] which was 37.2g. The charge collector of 10 micrometers of copper foil was used for the negative electrodes which produced the electrode to positive electrodes, using the charge collector which cast aluminum by the vacuum deposition method to polyethylene terephthalate (PET) 14micrometer, and cast it by thickness of 1000A to both sides as example 11 charge collector, and the electrode was produced.
[0058] Using the above-mentioned conductive liner sheet, the positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0059] which was 39.2g. The charge collector of 10 micrometers of copper foil was used for the negative electrodes which used the charge collector of aluminum 20micrometer thickness for positive electrodes as example of comparison 1 charge collector, and produced the electrode, and the electrode was produced.
[0060] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is

[0061] which was 40.0g. The charge collector of 10 micrometers of nickel foils was used for the negative electrodes which used the charge collector of 20 micrometer thickness of nickel foils for positive electrodes as example of comparison 2 charge collector, and produced the electrode, and the electrode was produced.
[0062] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0063] which was 41.9g. The thickness of 20 micrometers of aluminium foil was used for positive electrodes as example of comparison 3 charge collector, the stainless steel 304 foil thickness of 10 micrometers was used for the negative electrodes which produced the electrode, and the electrode was produced.
[0064] The positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is
[0065] which was 39.2g. As example of comparison 4 resin sheet-like conductivity film, the conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated aluminum by the thickness of 500A to both sides for positive electrodes was produced.
[0066] The conductive liner sheet which fabricated with the vacuum deposition method on the film with a polyethylene terephthalate (PET) thickness of 14 micrometers, and fabricated copper by the thickness of 200A to both sides for negative electrodes was produced.
[0067] Using the above-mentioned conductive liner sheet, the positive electrode and the negative electrode were produced like the example 1, and assembled the eddy winding pattern cell like the example 1. The weight of the assembled cell is [0068] which was 36.7g. It is Table 1 which summarized the quality of the material of a positive-electrode current collection layer, the quality of the material and thickness of the thickness and a negative-electrode current collection layer, and cell weight about the above examples 1-11 and examples 1-4 of a comparison.
[0069]
[Table 1]

	正極集電体	厚み	負極集電体	厚み	電池重量
実施例1	アルミニウム	500Å	ニッケル	500Å	36.8g
実施例2	アルミニウム	1000Å	ニッケル	1000Å	36.8g
実施例3	アルミニウム	2000Å	ニッケル	2000Å	36.8g
実施例4	アルミニウム	500Å	銅	1000Å	36.8g
実施例5	アルミニウム	1000Å	ニッケル	500Å	37.0g
実施例6	アルミニウム	1000Å	ニッケル	1000Å	36.8g
実施例7	アルミニウム	2000Å	銅	1μm	37.3g
実施例8	アルミニウム	5000Å	銅	2μm	37.9g
実施例9	アルミニウム	1μm	ニッケル	2000Å	37.0g
実施例10	アルミニウム	2μm	銅	0.5μm	37.2g
実施例11	アルミニウム	1000Å	銅	10μm	39.2g
比較例1	アルミニウム	20μm	銅	10μm	40.0g
比較例2	ニッケル	20μm	ニッケル	10μm	41.9g
比較例3	アルミニウム	20μm	SUS	10μm	39.2g
比較例4	アルミニウム	500Å	銅	200Å	36.7g

[0070] Next, the cycle which carries out 3.5hr charge by charging current 0.5A and upper limit electrical-potential-difference 4.20V, uses a 6-ohm resistance element next using the cell of the examples 1-11 shown in Table 1 and the examples 1-4 of a comparison, and is made to discharge to 2.5V was performed. The result of having measured an internal resistance value, 5 cycle eye discharge capacity, 10 cycle eye discharge capacity, weight energy density, 100 cycle eye discharge capacity, and 2A load discharge capacity about the cell of examples 1-11 and the examples 1-4 of a comparison is as being shown in Table 2.

[0071]

[Table 2]

	内部抵抗値 at1kHz	5サイクル目放電容量	10サイクル目放電容量	重量エネルギー密度	100サイクル目放電容量	2A負荷放電容量
実施例1	68mΩ	1230mAh	1200mAh	115 Wh/kg	1105mAh	850mAh
実施例2	70mΩ	1250mAh	1210mAh	114 Wh/kg	1110mAh	845mAh
実施例3	69mΩ	1230mAh	1200mAh	114 Wh/kg	1100mAh	820mAh
実施例4	69mΩ	1210mAh	1190mAh	114 Wh/kg	1090mAh	815mAh
実施例5	66mΩ	1250mAh	1210mAh	115 Wh/kg	1100mAh	840mAh
実施例6	68mΩ	1230mAh	1200mAh	114 Wh/kg	1095mAh	820mAh
実施例7	70mΩ	1220mAh	1200mAh	115 Wh/kg	1090mAh	810mAh
実施例8	68mΩ	1220mAh	1200mAh	113 Wh/kg	1080mAh	820mAh
実施例9	71mΩ	1210mAh	1190mAh	115 Wh/kg	1090mAh	800mAh
実施例10	70mΩ	1215mAh	1190mAh	115 Wh/kg	1080mAh	790mAh
実施例11	65mΩ	1230mAh	1210mAh	110 Wh/kg	1090mAh	730mAh
比較例1	63mΩ	1250mAh	1210mAh	109 Wh/kg	1100mAh	840mAh
比較例2	70mΩ	1250mAh	1210mAh	104 Wh/kg	1050mAh	790mAh
比較例3	75mΩ	1200mAh	1180mAh	109 Wh/kg	1060mAh	780mAh
比較例4	78mΩ	1125mAh	1100mAh	102 Wh/kg	1010mAh	610mAh

[0072] Thus, the engine performance in which all of the charge-and-discharge cycle engine performance are almost equivalent is obtained, and while charge and discharge can be equal to practical use, in case a cell is applied to portable, it is very much effective [it acts advantageously, and] from that the weight of a cell can carry out [lightweight]-izing not using a metallic charge collector. Even if it faces weight energy density improving also by the above-mentioned result, and newly enlarging a cell, effectiveness is large, it is lightweight in a cell, and it is effective in case what has an output big moreover is made.

[0073] Moreover, by using the resin sheet for the sheet-like film of a charge collector, since the resin sheet with which the impact at the time of fall is distributed by both a separator and the current collection sheet has elasticity, it does not concentrate on one place like a metal body, but the surroundings also transform it, and it does not result in too much stress concentration.

[0074] Since it is resin, therefore it does not carry out linear fracture seen with a metal but becomes the destruction the sheet itself goes out [destruction] with elongation and it goes to a certain force, instantaneous fracture with the whole charge collector is not carried out, but the gestalt destroyed gradually is taken.

[0075] Lightweight-izing of a cell is possible by using the thin film object of the resin sheet which has a conductive metal on a front face as a charge collector of an electrode from the above thing according to this example, and using the sheet which has the conductivity in the range of this invention also from the point that the engine performance equivalent to the metallic foil used from the former can be demonstrated by having this predetermined conductive layer thickness makes effectiveness size extremely.
[0076] In order to have the reinforcement of a sheet above to some extent in order to apply positive/negative Mix practical about the thickness of the resin sheet used as a conductive current collection sheet, and to maintain the homogeneity of a paint film, the breaking strength of 3 or more kgf/cm is required so that hauling by the machine can be borne. It is desirable to use the sheet of 4 kgf/cm from from [in maintaining especially the homogeneity of a paint film].
[0077] In order to prevent that manufacture of a conductive thin film becomes difficult as thickness of a conductive thin film, it is desirable that it is 5 micrometers or more. Moreover, it is desirable that it is 20 micrometers or less from membranous reinforcement, the moldability of an electrode, and the point of cell weight.
[0078] What has the thinner electric conduction film from lightweight-izing of a cell is desirable, and it is desirable that it is in the range which is about 0.05-2 micrometers of one side (refer to drawing 2). Moreover, in order to secure a flow with an active material, a certain thing of electric conduction film thickness is desirable about 0.02 micrometers or more.
[0079] In addition, this invention is not limited to the example mentioned above not necessarily. That is, as resin sheet-like film, others, other polyester, a polyether ether ketone, polyimide, or polypropylene etc. can be used. [polyester /, such as PET, PBT, or PEN]
[0080] Moreover, when using as a positive electrode as a conductive metal of the surface of the sheet-like film, nickel platinum besides aluminum or nickel, titanium, or zinc can be used. Moreover, when using as a negative electrode, palladium besides copper, nickel, or SUS, silver, or titanium can be used.
[0081] Moreover, as the shaping approach of the surface electric conduction film, the method of sticking an electrolytic plating foil (2 micrometers or less) besides a vacuum deposition method or an electroless deposition method by pressure or the metal **** thin film fabricating method can be used.
[0082] Moreover, it is realizable also about the manufacture approach of an electrode also except the approach of describing at this example. The active material of an electrode can use various things, and if it is a nonaqueous electrolyte cell, it can especially apply all.
[0083] as positive active material -- LiCoO2 others -- LiNiO2 -- LiCoxNi1-x O2, LiMn 2O4, and LiMnO2, LiFeO2, MoO2, MoO3, MoS2, and TiS2, LiTiO2, V2 O5, V3 O6, Lix VOy, and MnO2 Various ingredients are usable. etc. -- Other carbon and lithium metallic compounds of a metal lithium besides the carbon material near glassy carbon as a negative-electrode active material in which a dope / dedope of a lithium alloy and a lithium are possible natural are usable.
[0084] Moreover, the configuration of a cell is applicable to configurations, such as plate-like besides cylindrical, and a rectangular parallelepiped.
[0085] Moreover, as for this invention, it is needless to say that various configurations can be taken in addition to this, without deviating from the summary of not only an above-mentioned example but this invention.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing one example of this invention nonaqueous electrolyte rechargeable battery.
[Drawing 2] It is drawing showing the relation between electric conduction film thickness and weight energy density.
[Description of Notations]
1 Negative Electrode
2 Positive Electrode
3 Separator
4 Electric Insulating Plate
5 Cell Can
6 Obturation Gasket
7 Cell Lid
8 Relief Valve Equipment
9 PTC Component
10 Negative-Electrode Charge Collector
11 Positive-Electrode Charge Collector
12 Negative-Electrode Lead
13 Positive-Electrode Lead
14 Center Pin

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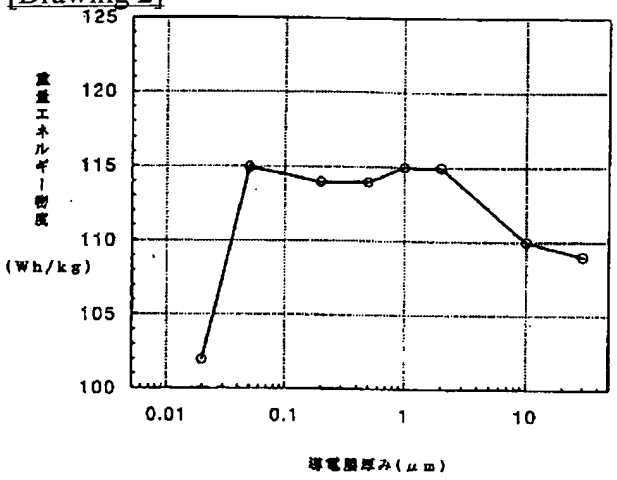
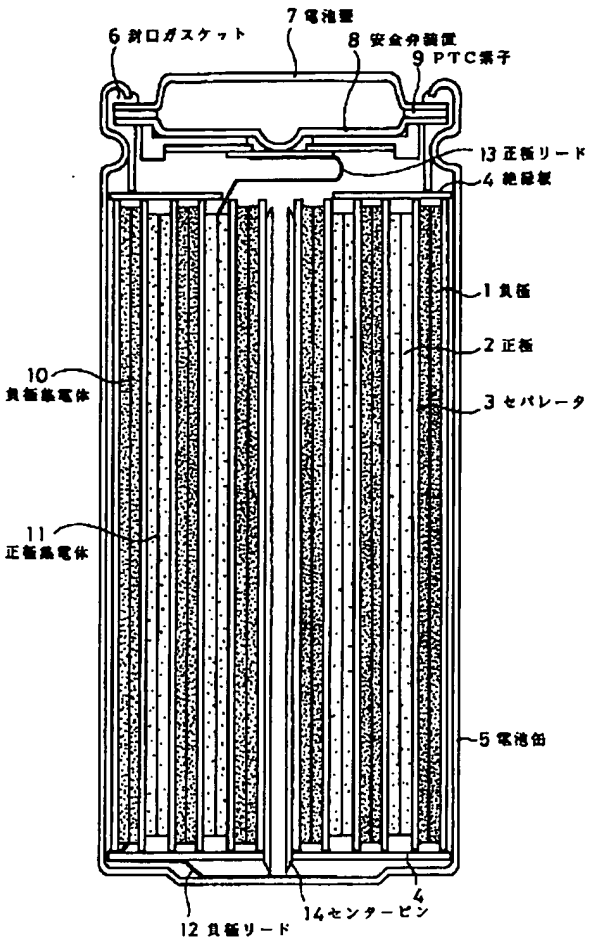
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 2]



[Drawing 1]



[Translation done.]